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INSECT PEST SURVEY BULLETIN  
JUL 17 1942

Vol. 22

Supplement to No. 3

U. S. Department of Agriculture June 10, 1942

POPULATIONS AND HOST PREFERENCES OF JUNE BEETLES (PHYLLOPHAGA SPP.)  
IN SOUTHERN WISCONSIN IN 1941, WITH A SUMMARY OF SIMILAR INFORMATION  
FOR THE PERIOD 1935-1941, INCLUSIVE

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The study of the flights, populations, and host preferences of June beetles in southern Wisconsin has been continued since 1934. Accounts of the flights of 1935-37, inclusive, of 1938, and of 1940 were given in the Insect Pest Survey Bulletin, Supplement to No. 4, Volume 18; Supplement to No. 3, Volume 19; and Supplement to No. 9, Volume 20, respectively. Methods of study, flight habits, and temperature reactions of the beetles are discussed in some detail in those reports. The work was completed as a major project in 1941; consequently this report includes a summary of the results for the 7-year period, as well as a more detailed account for the year 1941.

STUDIES IN 1941

In the 1941 studies eight main groves were used, in addition to a few others from which supplementary collections were made. Seven of the 8 groves had been used previously. They were located near the following towns or villages: Poynette and Leeds, Columbia County; Ripon, Fond du Lac County; Dane, Dane County; Lamont, Lafayette County; Linden, Iowa County; and Gays Mills, Crawford County. The eighth grove was near Wisconsin Rapids, Wood County. The location of these groves is shown in figure 1. As formerly, the Gays Mills area, which was studied more intensively than any of the others, is considered separately, whereas the other areas are grouped. Twelve flight observations were made at Gays Mills between April 26 and July 1, and 13 in other areas between April 30 and June 18. All beetles collected were hand-picked from their host plants.

Numbers and Species of Beetles Collected

In the Gays Mills area 12 species of Phyllophaga were taken, which, in a decreasing order of abundance, were as follows: P. rugosa (Melsh.), P. fusca (Froel.), P. hirticula (Knoch), P. balia (Say), P. ilicis (Knoch), P. tristis (F.), P. prunina Lec., P. implicita Horn, P. marginalis (Lec.), P. drakei (Kby.), P. nitida (Lec.), and P. inversa (Horn). P. rugosa, P. fusca, and P. hirticula comprised 56.64 percent, 28.14 percent, and 7.65 percent, respectively, of the total beetles taken, and altogether made up 92.43 percent of the total. The number of beetles of each species may be found in table 1.

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Table 1. June beetles taken from host plants in 1941

Species	At	From areas other	Total
	Gays Mills	than Gays Mills	
	Number	Number	Number
<i>P. hirticula</i> .....	192	1,986	2,178
<i>P. fusca</i> .....	706	1,342	2,048
<i>P. rugosa</i> .....	1,421	540	1,961
<i>P. balia</i> .....	122	12	134
<i>P. ilicis</i> .....	48	49	97
<i>P. tristis</i> .....	10	77	87
<i>P. futilis</i> .....	0	32	32
<i>P. drakei</i> .....	1	31	32
<i>P. nitida</i> .....	1	30	31
<i>P. implicita</i> .....	2	28	30
<i>P. prunina</i> .....	3	25	28
<i>P. marginalis</i> .....	2	10	12
<i>P. crenulata</i> .....	0	21	21
<i>P. anxia</i> .....	0	11	11
<i>P. inversa</i> .....	1	0	1
Total .....	2,509	4,194	6,703

From areas other than Gays Mills, 14 species were taken. These included 11 of the 12 species collected at Gays Mills and 3 others--Phyllophaga futilis Lec., P. crenulata (Froel.), and P. anxia Lec. The most common species, in a diminishing order of abundance, were P. hirticula, P. fusca, P. rugosa, P. tristis, and P. ilicis. P. hirticula, P. fusca, and P. rugosa made up 47.35, 32.00, and 12.88 percent, respectively, of the total number of beetles taken, and altogether constituted 92.23 percent. The actual numbers of all species taken from areas outside the Gays Mills area, as well as the total numbers of beetles of each species taken in all areas, are given in table 1.

#### Host Preferences of the Beetles

In the Gays Mills area Phyllophaga rugosa was collected from 22 kinds of plants, 9 of which yielded 86.34 percent of the total. P. fusca was taken from 20 kinds of plants, 4 of which yielded 86.68 percent of the total. P. hirticula was taken from 10 kinds of plants, 4 of which supplied 89.58 percent of the total. P. balia was also taken from 10 kinds of plants, 4 of which gave 86.69 percent of the total. P. ilicis was taken from 9 kinds of plants, 5 of which supplied 85.42 percent of the total. The principal hosts of these species and the percentage of the total furnished by each are given in table 2.

Table 2. Beetles taken from varicus host plants in Gays Mills area in 1941

Host plant	P. rugosa		P. fusca		P. hirticula		P. balia		P. ilicis	
	Num- ber	Per- cent	Num- ber	Per- cent	Num- ber	Per- cent	Num- ber	Per- cent	Num- ber	Per- cent
Cherry (cult.) ...	582	26.88	55	7.79	33	17.19	--	--	5	10.42
Butternut .....	189	13.30	362	51.27	73	38.02	19	15.57	14	29.17
Hazel .....	144	10.13	33	4.67	37	19.27	--	--	13	27.08
Hickory .....	131	9.22	162	22.95	29	15.10	74	60.66	5	10.42
Elm .....	114	8.02	--	--	--	--	--	--	--	--
Crataegus spp. ...	102	7.18	--	--	--	--	7	5.74	4	8.33
Populus grandi- dentata .....	60	4.22	--	--	--	--	--	--	--	--
Populus tremu- loides (aspen) ...	58	4.08	--	--	--	--	--	--	--	--
Basswood .....	47	3.31	--	--	--	--	--	--	--	--
Wild crab (Pyrus)	--	--	--	--	--	--	6	4.92	--	--
Total .....	1,227	86.34	612	86.68	172	89.58	106	86.89	41	85.42

A complete list of all hosts of all species collected at Gays Mills, with various other data, is given in table 3. This table is similar to the complete tables in the reports previously cited. There are three entries in each space, which, reading from the top, consist of a percentage, a number, and a percentage. The top percentage represents the percentage of the beetles of the species named at the head of the column, taken from the host plant at the left, the middle figure the number of beetles of the species taken from the host at the left, and the percentage at the bottom of the space the percentage of the total beetles from the host at the left supplied by the species at the head of the column. Thus, 13.30 percent of the beetles of the species Phyllophaga rugosa were taken from butternut. The number of beetles of this species from butternut was 189, and the number of P. rugosa beetles from this host represented 28.64 percent of the total beetles of all species from this host.

In areas outside of the Gays Mills district, Phyllophaga hirticula was collected from 16 kinds of plants. Four of these supplied 90.03 percent of the total beetles of this species. P. fusca was collected from 17 kinds of plants, of which 7 supplied 92.78 percent of the total. P. rugosa was taken from 18 kinds of plants, 86.67 percent being supplied by 6 kinds. P. tristis was taken from 4 kinds of plants, 98.71 percent being supplied by 3 of them. P. ilicis was collected from 5 kinds of plants, of which 2 supplied 91.83 percent of the total. P. futilis was found on 8 kinds of plants, 4 of which supplied 87.51 percent of the total beetles. A list of the principal hosts of these more important species is given in table 4.

Table 4. Beetles taken from host plants outside of Gays Mills area in 1941

Host plant	P. hirticula		P. fusca		P. rugosa		P. tristis		P. ilicis		P. futilis	
	Num- ber	Per- cent	Num- ber	Per- cent	Num- ber	Per- cent	Num- ber	Per- cent	Num- ber	Per- cent	Num- ber	Per- cent
Hazel....	1353	68.13	95	7.08	140	25.93	--	--	42	85.71	18	56.25
Bur oak .	314	15.81	158	11.77	27	5.00	57	74.03	3	6.12	3	9.38
Red oak group .	64	3.22	164	12.22	66	12.22	9	11.69	--	--	--	--
Aspen ...	57	2.87	130	9.69	140	25.93	--	--	--	--	--	--
Dogwood .	--	--	515	38.38	48	8.89	--	--	--	--	--	--
Hickory .	--	--	97	7.23	47	8.70	--	--	--	--	--	--
White oak .	--	--	86	6.41	--	--	10	12.99	--	--	--	--
Elm ....	--	--	--	--	--	--	--	--	--	--	5	15.63
Raspberry	--	--	--	--	--	--	--	--	--	--	2	6.25
Total .	1788	90.03	1245	92.78	468	86.67	76	98.71	45	91.83	28	87.51

In table 5 are listed all species collected, with their hosts, in the same way the species are listed for the Gays Mills area in table 3.

Summary of Populations and Host Preferences of the Principal Species from 1935 to 1941, Inclusive

During the 7-year period 1935-41, inclusive, collections were made from 28 groves which, with 1 exception, were in the southern half of the State. The location of these groves is shown in figure 2. June beetles (according to the listing in the tables as they appear in the reports mentioned) were collected from 69 kinds of host plants, the identity of 4 being uncertain. Oaks of the red oak group, and occasionally other closely related plants, were not separated as to species, owing to difficulty in making accurate determinations at night; therefore, over 70 species are actually represented. A total of 56,344 beetles were collected. The most common beetles for the 7-year period were as follows:

Species	Number	Percent
P. rugosa .....	19,354	34.35)
P. hirticula ....	17,785	31.57) 87.93
P. fusca .....	12,402	22.01)
P. implicita ....	1,651	2.93
P. tristis .....	1,185	2.10
P. ilicis .....	1,097	1.95
Total .....	53,474	94.91

TABLE 8  
Beetles Collected in the Gays Mills Area, 1941

Hosts	<i>P.rugosa</i>	<i>P.fusca</i>	<i>P.hirticula</i>	<i>P.balia</i>	<i>P.lilicis</i>	<i>P.tristis</i>	<i>P.prunina</i>	<i>P.implicita</i>	<i>P.marginalis</i>	<i>P.inversa</i>	<i>P.nitida</i>	<i>P.drakii</i>	Totals
Butternut	13.50%	51.27%	38.02%	15.57%	29.17%	10.00%	66.67%						26.31%
	189	882	73	19	14	1	2						660
	28.84%	54.85%	11.06%	2.88%	2.12%	.15%	.30%						100.00%
Cherry (Cultivated)	26.56%	7.75%	17.19%	.82%	10.42%			50.00%			100.00%		19.05%
	382	55	55	1	5			1			1		478
	79.92%	11.51%	6.90%	.21%	1.05%			.21%			.21%		100.01%
Hickory	9.22%	22.35%	15.10%	60.38%	10.42%	10.00%			50.00%			100.00%	16.15%
	131	182	29	74	5	1				1		1	404
	32.43%	40.10%	7.15%	18.52%	1.24%	.25%						.25%	100.00%
Hazel	10.15%	4.87%	19.27%	4.92%	27.05%	20.00%			50.00%				9.41%
	144	53	57	6	13	2				1			236
	61.02%	13.98%	15.05%	2.64%	5.51%	.85%							100.00%
Catasperus	7.10%	5.82%	4.69%	5.74%	6.35%								5.84%
	102	27	9	7	2								149
	68.48%	18.12%	6.04%	4.70%	2.39%								100.00%
Birch	8.02%	.67%		2.48%				50.00%					4.86%
	114	4		3						1			122
	83.44%	5.23%		2.46%									100.00%
Populus (grandi dentata)	4.22%	.28%											2.41%
	60	2											62
	56.77%	5.23%											100.00%
Basswood	3.81%	1.42%	.52%		4.17%								2.33%
	47	10	1		2								60
	76.33%	16.67%	1.87%		3.33%								100.00%
Aspen	4.08%		.52%										2.33%
	59		1										59
	98.31%		1.69%										100.00%
White Oak	1.87%	2.65%		.32%	2.09%	30.00%							1.81%
	24	19		1	1	5							48
	50.00%	33.55%		2.09%	2.09%	6.25%							99.95%
Willow	3.10%	.23%	.52%				33.33%						1.81%
	44	2	1										48
	91.67%	4.17%	2.09%				2.09%						100.00%
Ironwood	1.84%	.28%	5.13%	5.28%	6.25%								1.63%
	28	2	6	4	3								41
	68.41%	4.88%	14.63%	9.79%	7.32%								100.00%
Poplar	1.65%	.57%											1.12%
	24	4											28
	35.71%	14.29%											100.00%
Red Oak (Group)	1.05%	.55%	1.04%	.82%		20.00%				100.00%			1.05%
	15	5	2	1		2				1			27
	55.56%	22.22%	7.41%	3.70%		7.41%							100.00%
Apple (Cultivated)	1.85%						10.00%						1.05%
	28												27
	95.30%						3.70%						100.00%
Box Elder	1.55%	.28%											.95%
	22	2											24
	91.87%	8.33%											100.00%
Raspberry	.35%	.67%			2.09%								.40%
	5	4											10
	50.00%	40.00%			10.00%								100.00%
Wild Crab (Pyrus)	.07%	.42%		4.93%									.45%
	1	3		6									10
	10.00%	30.00%		60.00%									100.00%
Ash		.67%											.15%
		4											4
		100.00%											100.00%
Sumac	.21%												.12%
	3												3
	100.00%												100.00%
Dogwood		.28%											.05%
		2											2
		100.00%											100.00%
Plum (Wild)		.28%											.05%
		2											2
		100.00%											100.00%
Cherry (Choate)	.14%												.05%
	2												2
	100.00%												100.00%
Thistle (Bull)		.14%											.04%
		1											1
		100.00%											100.00%
Wist		.07%											.04%
		1											1
		100.00%											100.00%
Sp.?		.07%											.04%
		1											1
		100.00%											100.00%
Totals	99.95%	99.95%	100.00%	100.01%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.01%
	1421	706	192	122	48	10	3	2					2509
	55.64%	29.14%	7.65%	4.55%	1.91%	.40%	.12%	.08%	.06%	.04%	.04%	.04%	100.00%



The number given for Phyllophaga tristis in this list is too small, for the reason that this species feeds extensively on the high parts of large oak trees, largely to the exclusion of other plants, and in 1936, when there was a tremendous flight of this species and extremely small flights of the others, their relative abundance could not be ascertained. The number given was derived from collections from low shrubs and trees in groves where other species were present. The data should be fairly accurate, however, if the year 1936 is not considered.

The other beetles collected, listed in a descending order of populations, consisted of the following species: Phyllophaga prunina, P. drakei, P. balia, P. futilis, P. nitida, P. crenulata, P. anxia, P. marginalis, P. spreta (Horn), P. inversa, P. fosteri (Burm.), P. vilifrons (Lec.), and P. sp.?, making a total of 18 determined and 1 undetermined species.

The chief host plants of June beetles in general are given in table 6, and the chief host plants of the principal species in table 7. An examination of table 6 shows definitely the importance of hazel brush, bur oak, and hickory as food for the beetles and indicates that if destruction of any considerable portion of the principal species of June beetles is attempted by spraying, the low shrub, hazel, must be sprayed in addition to the trees. Where protection of valuable trees or shrubs is the objective, rather than materially reducing the numbers of adults and grubs in any considerable area, spraying is effective.

Table 6.—Chief host plants of all species of June beetles collected, 1935-41

Host plant	Beetles collected	
	Number	Percentage of total
Hazel.....	12,173	21.60
Bur oak.....	8,105	14.38
Hickory.....	5,247	9.31
Cherry (cultivated).....	4,731	8.40
Populus spp., mostly aspen...	4,677	8.30
Red oak group.....	4,122	7.32
Butternut.....	3,971	7.05
Dogwood.....	3,252	5.77
Willow.....	2,186	3.88
White oak.....	1,334	2.37
Total.....	49,798	88.38

Table 7.—Chief hosts of principal species of June beetles collected 1935-41, with percentage of each species collected from plants named.

Host plant	P. rugosa	P. hirticula	P. fusca	P. impunctata	P. tristis	P. ilicis	P. futilis	
	Num- ber	Per- cent	Num- ber	Per- cent	Num- ber	Per- cent	Num- ber	Per- cent
Cherry (cult.).....	3,523	18.20	—	—	1,066	8.60	—	—
Hickory.....	2,474	12.76	1,297	7.29	1,136	9.16	—	—
Butternut.....	2,023	10.52	—	—	1,444	11.61	—	—
Hazel.....	1,929	9.97	8,077	45.41	856	6.90	—	—
Populus spp. mostly aspen.....	1,884	9.73	—	—	1,408	11.35	742	44.94
Willow.....	1,147	5.93	—	—	—	—	788	47.73
Red oak group.....	1,098	5.67	731	4.11	1,194	9.63	—	—
Bar oak.....	906	4.68	5,097	28.66	1,321	10.65	—	—
Basswood.....	706	3.65	—	—	—	—	715	60.34
Elm.....	536	3.29	—	—	—	—	—	—
Dogwood.....	—	—	—	—	2,343	18.89	—	—
White oak.....	—	—	—	—	—	—	53	4.47
Ironwood.....	—	—	—	—	—	—	—	—
Prickly ash.....	—	—	—	—	—	—	—	—
Plum (cult.).....	—	—	—	—	—	—	—	—
Rose (wild).....	—	—	—	—	—	—	—	—
Raspberry.....	—	—	—	—	—	—	—	—
Plum (wild).....	—	—	—	—	—	—	—	—
Gooseberry.....	—	—	—	—	—	—	—	—
Locust.....	—	—	—	—	—	—	—	—
Total.....	16,326	84.42	15,202	85.47	10,770	86.79	1,530	92.67
							1,041	1,041
							87.85	891
							81.22	336
								85.42

\* In the Blue Mounds grove, where both hazel and prickly ash (Xanthoxylum americanum) are abundant, prickly ash appears to be the preferred host.

TABLE 6  
Beetles Collected in Southern Wisconsin Outside of Gays Mills Area, 1941

Hosts	P.hirticula	P.fusca	P.rugosa	P.tristis	P.lilicis	P.futilis	P.draekii	P.mitida	P.implacata	P.crenulata	P.balia	P.anxia	P.marginalis	Totals
Hazel	68.13%	7.08%	25.93%		85.71%	56.25%	51.61%	46.67%	10.71%	32.00%	61.90%	8.33%	18.18%	20.00%
	1353	96	140		42	18	16	14	5	8	18	1	2	1707
	79.28%	5.56%	8.20%		2.46%	1.05%	.94%	.83%	.18%	.47%	.76%	.06%	.12%	100.01%
Dogwood	.50%	58.38%	8.69%		2.04%	3.13%	25.61%	26.67%			4.76%	25.00%	9.09%	30.00%
	10	515	48		1	1	8	8			1	3	1	599
	1.87%	85.98%	8.01%		.17%	.17%	1.34%	1.34%			.17%	.50%	.17%	100.02%
Bur Oak	15.61%	11.77%	6.00%	74.03%	6.12%	9.58%	5.23%	6.67%				50.00%		14.23%
	314	158	27	57	3	3	1	2				6		571
	54.99%	27.67%	4.73%	9.99%	.53%	.53%	.18%	.35%				1.05%		100.01%
Aspen	2.87%	9.69%	25.93%		4.08%				78.57%				18.18%	10.00%
	67	130	140		2				22				2	354
	16.10%	36.73%	39.55%		.56%				6.21%				.56%	99.93%
Red Oak (Group)	3.22%	12.22%	12.22%	11.69%					9.68%	6.67%	40.00%			30.00%
	64	164	86	9					3	2	10			321
	19.94%	51.09%	20.56%	2.80%					.93%	.62%	3.12%			99.93%
White Oak	1.86%	6.41%	4.81%	12.95%						20.00%		8.33%		10.00%
	37	86	28	10							5	1		185
	22.29%	51.61%	15.66%	8.02%							3.01%		.60%	99.93%
Hickory	1.01%	7.23%	8.70%									8.33%		3.93%
	20	97	47									1		165
	12.12%	55.79%	28.48%									.81%		100.00%
Crataegus sp.	3.02%	.07%	1.11%		2.04%									1.62%
	80	1	6		1									88
	88.24%	1.47%	8.82%		1.47%									100.00%
Plum (Wild)	.10%	2.63%	1.11%	1.30%		3.13%								1.05%
	2	34	6	1										44
	4.55%	77.27%	13.84%	2.27%										100.00%
Elm	.96%	.67%	.56%			15.63%			10.71%			36.36%		1.05%
	19	9	5						5	3		4		45
	44.13%	20.93%	6.98%			11.63%			6.98%			9.30%		100.01%
Raspberry	1.01%	1.12%				6.25%			6.67%					.53%
	20	15							2	2				39
	51.25%	36.46%				5.13%			5.13%					100.00%
Butternut	.55%	1.12%	2.41%											.53%
	11	15	13											39
	28.21%	38.45%	33.33%											100.00%
Bitternut	.10%	.57%	.74%											.45%
	2	18	4											19
	10.53%	68.42%	21.05%											100.00%
Rose (Wild)	.45%	.30%	.18%						3.33%		14.29%			.45%
	9	4	1						1		3			18
	50.00%	22.22%	5.56%						5.56%		16.67%			100.01%
Willow	.20%		.74%											.19%
	4		4											8
	50.00%		50.00%											100.00%
Blueberry									8.45%		19.05%			.14%
									2		4			6
									33.33%		66.67%			100.00%
Cherry (Choke)	.20%		.19%											.13%
	4		1											5
	80.00%		20.00%											100.00%
Blackberry (Wild)		.07%	.37%							8.00%				.13%
		1	2							2				5
		20.00%	40.00%							40.00%				100.00%
Box Elder			.74%											.10%
			4											4
			100.00%											100.00%
Woodbine		.22%												.07%
		3												3
		100.00%												100.00%
Gooseberry		.15%												.05%
		2												2
		100.00%												100.00%
Basswood														.05%
			.37%											2
			2											100.00%
Grape (Wild)			100.00%											.05%
									3.13%					1
									1					100.00%
Apple									100.00%					.05%
														1
														100.00%
Grass (Undetermined)									3.13%					.05%
									1					1
									100.00%					100.00%
Thorny Shrub (Undetermined)									3.23%					.05%
									1					1
									100.00%					100.00%
Weed (Undetermined)									3.33%					.05%
									1					1
									100.00%					100.00%
Totals	99.99%	100.00%	100.01%	100.01%	99.99%	100.00%	100.01%	100.00%	99.99%	100.00%	100.00%	99.99%	100.00%	99.98%
	1986	1342	640	77	49	32	31	30	28	25	21	12	11	4194
Totals		47.55%	32.00%	12.88%	1.84%	1.17%	.76%	.74%	.67%	.60%	.50%	.26%	.24%	100.02%



It would appear from table 7 that control of adults by spraying would not be generally effective for Phyllophaga rugosa, P. fusca, and P. futilis, which have 10, 8, and 12 principal hosts, respectively. In the case of P. hirticula, P. tristis, and P. ilicis, better results might be obtained, because these species concentrate their feeding on fewer kinds of plants. The species of grubs most common in cereal and forage crops, however, have been P. rugosa, P. hirticula, and P. fusca. Grubs of P. tristis and P. futilis occasionally have been numerous in these crops in some localities. P. ilicis grubs have not been found in the field.

In considering the data in tables 6 and 7, it should be borne in mind that while these data show clearly the kinds of plants preferred by various species of June beetles for food, they are not an entirely accurate measure of the importance of the various plants as hosts in all localities. For example, in large areas where Phyllophaga hirticula is numerous, the host plant bur oak is more abundant than is hazel, and individual plants furnish much more foliage to be fed upon than do individual hazel plants. In regard to cultivated cherry, which supplied many of the P. rugosa and P. fusca beetles collected, this plant can be important only in those limited areas in which it is grown commercially.



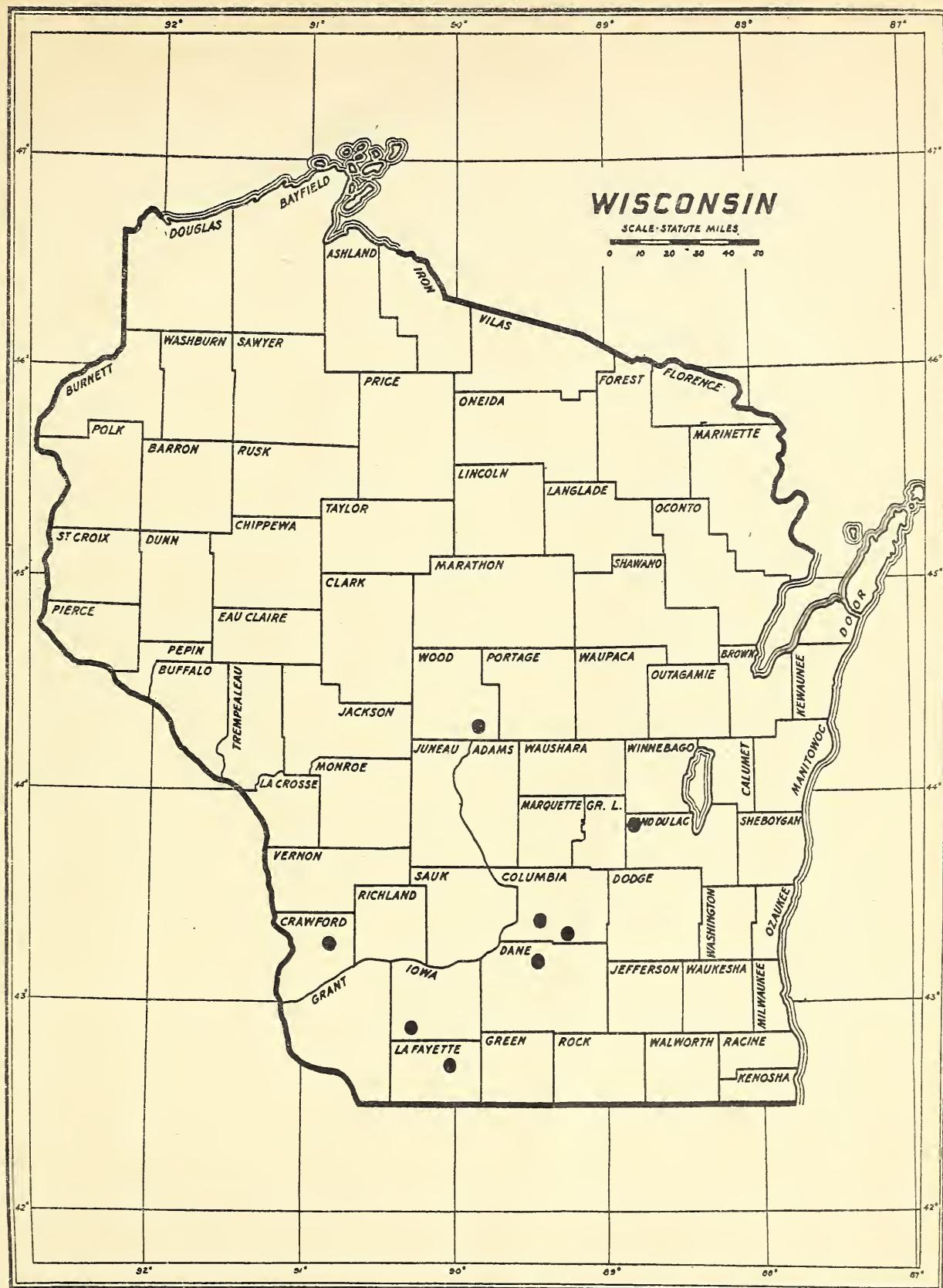


Figure 1.--Localities in which flight studies and collections were made in 1941.



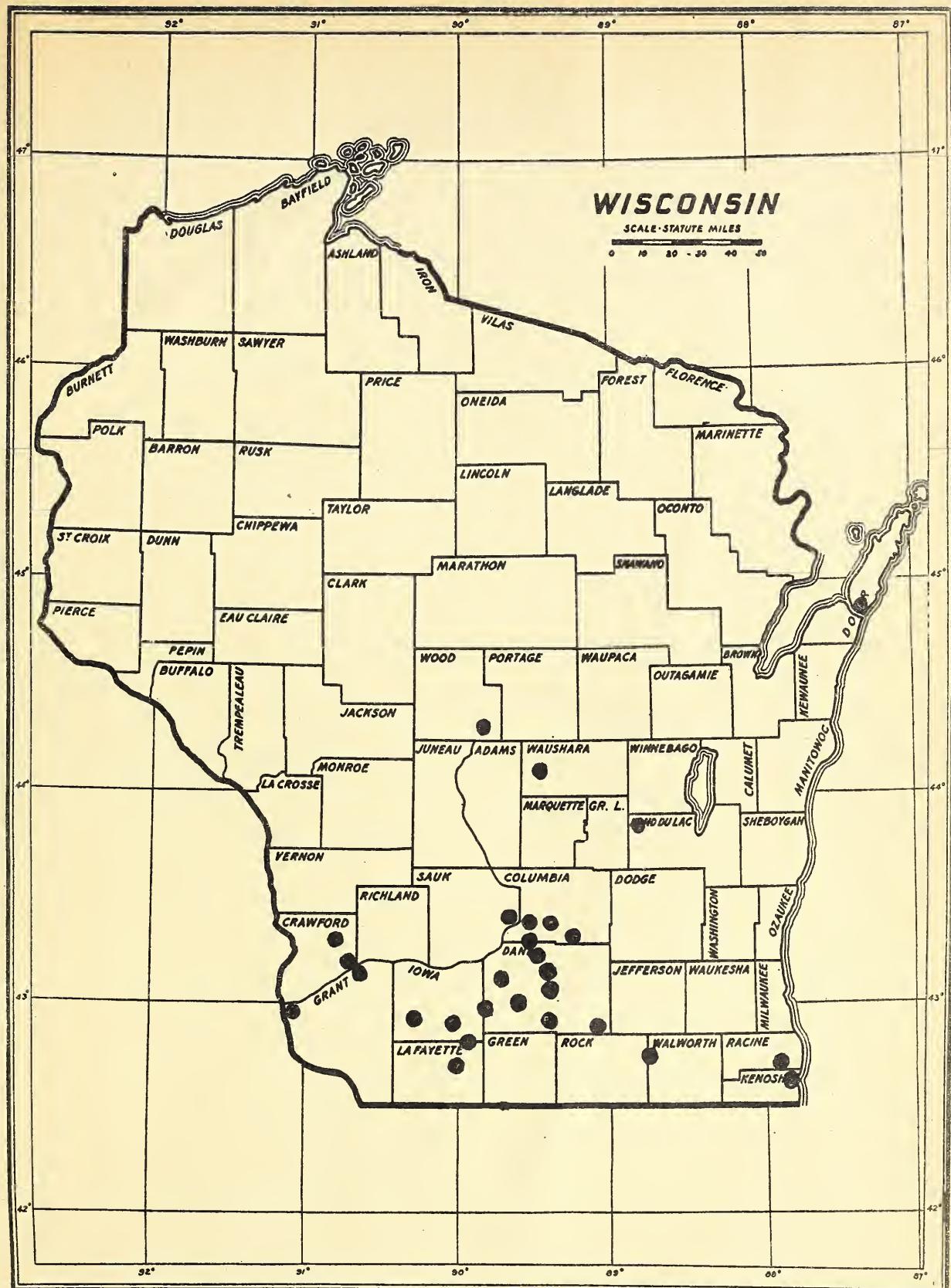


Figure 2.--Localities in which flight studies and collections were made during the period 1935-41, inclusive.

